BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 174 843 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication of patent specification: **18.12.91** (51) Int. Cl.[5]: **A61B 17/04**, A61B 17/32

(21) Application number: **85306453.3**

(22) Date of filing: **11.09.85**

Divisional application 91201180.6 filed on 11/09/85.

(54) Sewing machine.

(30) Priority: **11.09.84 GB 8422863**

(43) Date of publication of application:
19.03.86 Bulletin 86/12

(45) Publication of the grant of the patent:
18.12.91 Bulletin 91/51

(84) Designated Contracting States:
CH DE FR GB LI NL SE

(56) References cited:
CH-A- 645 012
DE-A- 1 685 043
GB-A- 2 050 448
US-A- 2 637 290
US-A- 4 235 238
US-A- 4 417 532

(73) Proprietor: **UNIVERSITY COLLEGE LONDON**
Gower Street
London WC1E 6BT(GB)

(72) Inventor: **Mills, Timothy Noel**
Flat 4 45 Newman Street
London W.1.(GB)
Inventor: **Swain, Christopher Paul**
52 Gloucester Avenue
London NW1 8JD(GB)

(74) Representative: **Boon, Graham Anthony et al**
Elkington and Fife Prospect House 8 Pembroke Road
Sevenoaks, Kent TN13 1XR(GB)

EP 0 174 843 B1

Description

This invention relates to sewing machines. The invention has particular application to sewing required in surgical procedures, and, more particularly, relates to sewing machines which can be used inside the body of a patient without the need to make an external incision in the patient, the machine being controlled externally of the patient, for example by endoscopic means. For convenience such a machine is referred to below as an endoscopic sewing machine, and the ensuing description relates largely to endoscopic sewing machines. It is to be understood, however, that sewing machines according to the present invention could be used in other applications.

GB-A-2050448 describes a sewing machine for forming stitches in a substrate, comprising means defining a slot open towards the substrate for receiving the substrate therein, thread carrying means for passing a thread into the substrate in the slot from one side of the substrate at a first location and for withdrawing the thread from the substrate on the same side at a second location spaced from the first location, the said means being remotely operable solely from the said one side of the substrate,

According to the present invention there is provided a sewing machine of the type just referred to, characterized in that it comprises means for drawing a U-shaped double layer of the substrate into the slot by suction.

The machines according to the present invention open up the possibility of performing a wide range of internal surgical procedures without having to make an external incision in the patient. Potential medical uses of such machines could include the oversewing of bleeding or perforated ulcers, the oversewing of bleeding varices, the narrowing of lax internal anatomical sphincters or organs, the closure of internal holes or fistulae, the assistance in the removal of normal or abnormal tissue, and the attachment of materials or objects to the walls of tissue (for example for attaching gastric tubes for feeding purposes to the wall of the stomach, or for attaching X-ray opaque markers to mark the site of, say, a cancer, or for attaching a piece of material containing a drug to permit localised internal treatment).

Figures 1a, 1b and 1c show a first embodiment of a sewing machine according to the present invention, in three successive stages of operation;

Figure 2 shows, by way of example, one stitch pattern which can be formed by the machine of Figures 1a to 1c;

Figures 3a and 3b are underplan and side elevational views respectively showing a second embodiment of a sewing machine; and

Figures 4a to 4h show diagrammatically the second embodiment of sewing machine in successive stages of operation, each Figure comprising two longitudinal sections through mutually perpendicular planes, in order to enable the operation of the machine to be more easily visualised in three dimensions, one of the longitudinal sections in each Figure being taken along the section line indicated in the other.

The embodiment shown in Figures 1a to 1c comprises a block 1 preferably formed of a transparent material, such as perspex. A slot 2 is formed in the block 1, the slot extending from the front to the back of the block, i.e. in a direction perpendicular to the plane of the paper. The block also has two longitudinal channels 3 and 4 formed therein. The channel 3 receives a needle 5 which is longitudinally slidable in the channel 3 under the control of a control wire 6. The needle 5 has a head portion 7 in which is formed an eye 8, and a thread 9 to be used in sewing is passed through the eye 8. The channels 3 and 4 are continuous with corresponding channels 17 and 18 formed in a two-channel endoscope tube 19.

The block 1 also has a compartment 10 formed therein, distal to the slot 2. A shoe 11 is mounted in the compartment 10. The rear portion 13 of the shoe 11 is resilient and serves to bias the shoe in an anti-clockwise direction into the position shown in Figure 1a. A hook 14 is mounted on the shoe 11 by means of a pin 12 for pivotal movement on the pin 12. The hook 14 is approximately in the shape of a V, and a control wire 15, which passes down the channels 4 and 18, is attached to the hook 14 adjacent the vertex of the V. A source of suction (not shown) is connected to the proximal end of channel 18 for a purpose which will be described below.

Turning now to the operation of the machine, the initial position is shown in Figure 1a, with the machine positioned above a layer of tissue 16 in which it is desired to form stitches. Suction is then applied to the slot 2 to suck into the slot a U-shaped double layer of tissue, as can be seen in Figure 1b. The depth of the slot 2 controls the amount of tissue which is sucked in. The needle 5 is then forced forwards through the double layer of tissue, as is also shown in Figure 1b. The needle carries with it the loop of thread 9. The tip of the needle strikes the shoe 11 which is thereby caused to pivot downwardly against the biassing force of the shoe portion 13. The control wire 15 is then pulled rightwardly to cause the hook 14 to pivot and thereby catch the loop of thread carried by the eye 8 of the needle 5. This can also be seen in Figure 1b. It should be mentioned at this point that the side of the head portion 7 of the needle has a

groove (not shown) formed therein to allow the hook 14 to pass between the head portion 7 and the thread carried thereby.

As shown in Figure 1c the needle is then withdrawn leaving the loop of thread held between the hook 14 and the shoe 11. The suction applied to the slot 2 is then released and the double layer of tissue leaves the slot. This is also shown in Figure 1c, from which it can be seen that the effect of the steps described above is to pass a loop of thread from one side of the tissue through the tissue at a first location and back out of the tissue on the same side at a second location from the first location. As will be appreciated, this has been done without requiring access to the opposite side of the tissue which one would expect to be inaccessible under normal circumstances.

The machine is then moved to the site of the next stitch, suction is re-applied and the needle passes through a double layer of tissue at a different point. It is possible to form a variety of different stitches using the machine, but one example is shown diagrammatically in Figure 2. This stitch pattern is formed by moving the machine between successive stitches in a direction perpendicular to the plane of the paper in the drawings of Figure 1a to 1c. Figure 2 is a view taken looking down on the upper surface of the tissue shown in Figures 1a to 1c, and it will be seen that each of the loops formed by the hook 14 and the shoe 11 passes through the preceding such loop. How this is achieved can be understood by imagining the effect of moving the needle forwardly from the position shown in Figure 1c, with suction reapplied to the slot 2 to suck the tissue into the slot. It will be appreciated that the forward end of the needle will pass through the loop of thread caught between the hook 14 and the shoe 11, carrying a new loop of thread with it. It should be mentioned that to assist this process a small groove can be formed in the upper surface of the shoe, up which the tip of the needle can slide. This enables the needle to pass under the loop of thread already caught between the hook and shoe, without the risk that the needle may simply push the existing loop further up the surface of the shoe. Once the needle has placed the second loop through the first loop the hook 14 is pivoted to allow the first loop to be cast off by pulling on the tail of the thread. The hook 14 is then pivoted downwardly again, so that when the needle is withdrawn the second loop of thead is caught thereby.

As already mentioned, the body 1 is preferably made of a transparent material, so as to make it easier for the operator to see, and hence control, the operation of the machine. The control mechanisms can pass down the channel of an existing endoscope, or the machine can be used independently with a small supervising endoscope passed in parallel with the control channel of the machine.

The embodiment shown in Figures 3a and 3b is modular in construction, and comprises modules A to G joined face to face and held in position by suitable means, for example, a pair of longitudinally extending bolts passing through aligned bores in the individual modules. In the embodiment illustrated the modules B and D are formed of a transparent material and the remaining modules are not, but others of the modules may be transparent, and indeed it is preferable for some purposes that at least the module A should be transparent.

The module A is the main body portion, and defines longitudinal channels 103 and 104, corresponding to the channels 3 and 4 shown in Figure 1. The channel 103 receives a needle 105, which is longitudinally slidable therein under the control of a control wire 106. The needle 106 has a head portion in which is formed an eye 108 and a thread to be used in sewing is passed through the eye. The channels 103 and 104 are continuous with corresponding channels 117 and 118 formed in a two-channel endoscope tube, the rest of the endoscope being omitted for simplicity in Figures 3a and 3b.

The module B has a slot 102 formed therein, which, as viewed in underplan view, extends across the central region of the module B and which, as viewed in elevation, extends from the top of the module to a location falling just short of the bottom.

The module B is separated by module C, which constitutes a spacer disc and which has an aperture 150 therein through which the needle 105 can pass, from the module D. Module D has a compartment 110 therein which is aligned with slot 102 in module B.

Modules E and F retain a pin 112 on which a U-shaped member 111 is pivotally mounted. The arms of the member 111 each carry a respective resilient wire 151. As can be seen in Figure 3a, the wires converge towards one another at their tips as viewed in underplan, and, as can be seen in Figure 3b, the tip portions of the wires are bent upwardly and one of the wires is longer than the other and thus extends further upwards than does the other.

A control wire 115, which passes down the channels 118 and 104 is attached to an arm 152 which is, in turn, rigidly connected to the U-shaped member 111.

The module G provides a curved or bevelled front end to the device, so as to increase the ease with which it can be introduced into a patient.

A source of suction (not shown) is connected to the proximal end of the channel 118 for a purpose which will be described in more detail below and which is basically similar to that for which the source of suction is used in the embodi-

ment of Figure 1.

The operation of the device of Figures 3a and 3b will now be described with reference to Figures 4a to 4h. It should be noted that these figures are diagrammatic in character. In each case module G has been omitted, and the modular construction of the remaining portion of the device has not been shown in detail.

The initial position is shown in Figure 4a with the machine positioned above a layer of tissue 116 in which it is desired to form stitches. Suction is then applied to the slot 102 via the channel 104 to suck into the slot a double layer of tissue, as can be seen in Figure 4b. The depth and width of the slot 102 controls the amount of tissue which is sucked in. The modular design of this embodiment makes it possible to vary the amount of tissue sucked in, and hence vary the size of the stitches, simply by removing module B and replacing it by a module having a different thickness of depth of slot.

The needle 105 is then forced forwards through the double layer of tissue, as shown in Figure 4c. The needle carries with it a loop of a thread 109. The needle passes behind the upwardly extending tip portions of both of the wires 151, as viewed in Figure 4c. The control wire 115 is then pushed leftwards, as shown in Figure 4c, to cause the U-shaped member 111 to pivot anti-clockwise and thus to cause the outer ends of the wires 151 to pass upwardly on the same side of the needle and through the loop of thread carried by the eye of the needle 105, that is to say, the wires pass between the needle and one of the runs of the thread to catch the same. The needle 105 is then withdrawn rightwards whilst the U-shaped member is rotated fully anti-clockwise carrying the thread upwards into the compartment 110. This is shown in Figure 4d. This last action forms the thread into a large diameter loop. This results from the fact that the wires 151 diverge from one another as considered in a direction running leftwardly from their tips.

The suction applied to the slot 102 is then released and the double layer of tissue, with the thread 109 passing through it, leaves the slot. This is also shown in Figure 4d.

The machine is then moved with respect to the tissue in any direction to the right of a plane drawn perpendicular to the plane of the paper and passing through the machine.

Thus, the machine could be moved rightwardly in a direction parallel to its length, or at any angle less than 90° with respect to the aforesaid direction. The step shown in Figure 4e is then carried out, that is to say, suction is re-applied and the needle caused to pass through a double layer of tissue at a different point to that where the needle passed through the tissue in step 4c. As can be seen in Figure 4e, the forward end of the needle passes through the loop of thread already held by the U-shaped member 111, carrying a second loop of thread with it. Once the needle has placed this second loop through the first loop, the U-shaped member is pivoted clockwise, as shown in Figure 4f. The wires 151, being resilient, are forced apart by the needle and thus pass one on either side of the needle as the U-shaped member 111 travels to the position shown in Figure 4f, in which it is below the needle. In so doing the wires 151 drop the first loop onto the second loop.

The member 111 is then pivoted anti-clockwise, as shown in Figure 4g, so as to catch the second loop carried by the eye of the needle. This is shown in Figure 4g. Both wires 151 at this stage lie against the needle 102 and between the needle 102 and the adjacent portion of the thread 109.

As shown in Figure 4h, the needle 102 is then withdrawn rightwardly and the member 112 is pivoted further in an anti-clockwise direction, carrying the second loop upwards with it. As also shown in Figure 4h, the suction is then released to allow the tissue to leave the slot 102.

The above procedure is repeated as many times as are necessary in order to produce the desired number of stitches.

Various modifications may be made to the embodiments described above. One of these is that the machine can be provided with a plurality of slots 2 into each of which a double layer of tissue may be sucked. A single needle can then pass through each of these double layers of tissue, thus making a plurality of stitches in a single operation. Also, it should be understood that the stitch forming part of the machine could be modified to correspond to that of any one of a number of conventional sewing machines. For example, the stitching mechanism could be one which uses two threads, rather than one as in the illustrated embodiments.

As mentioned above, the module A is preferably transparent. This is to make it easier for the operator to see, and hence control the operation of the machine. Visibility may further be improved, both in the embodiment of Figures 3 and 4 and in the embodiment of figure 1, by positioning a mirror in the slot 102 (or slot 2) at 45° to the longitudinal axis of the machine. By way of example this is shown diagrammatically as 153 in Figure 3b. This enables the user to see the double layer of tissue sucked into the slot 2. A still further improvement can be achieved by extending the endoscope optics right up to the slot 102 (or 2).

Claims

1. A sewing machine for forming stitches in a

substrate (16, 116), comprising means defining a slot (2, 102) open towards the substrate (16, 116) for receiving the substrate therein, thread carrying means (5, 105) for passing a thread (9, 109) into the substrate in the slot from one side of the substrate at a first location and for withdrawing the thread from the substrate on the same side at a second location spaced from the first location, the said means being remotely operable solely from the said one side of the substrate, characterized in that it comprises means (18, 118) for drawing a U-shaped double layer of the substrate into the slot (2, 102) by suction.

2. A machine according to claim 1, wherein the thread-carrying means (5, 105) is arranged for movement from a retracted position to an extended position, in which movement it carries a loop of thread into and through the said double layer and further comprising means (11, 14; 111) for catching the said loop after it has been passed through the said double layer and holding the said loop while the thread-carrying means (5, 105) is withdrawn to the retracted position.

3. A machine according to claim 2, wherein the catching means (11, 14; 111) is movable from a catching position to a position in which the loop caught is positioned so that subsequent movement of the thread-carrying means (5, 105) from said retracted position to said extended position carries a further loop of thread through the previously caught loop.

4. A machine according to any preceding claim, comprising a channel (18, 118) communicating with said slot for supplying the suction thereto to effect the said drawing in of the double layer.

5. A machine according to claim 4, as dependent on claim 2 or 3, comprising a block (1) having distal and proximal ends, the block (1) defining a compartment (10, 110) adjacent the distal end housing the catching means (11, 14; 111), said slot (2, 102) being defined in the block on the proximal side of the compartment, said suction-supplying channel (18, 118) being defined in the block on the proximal side of the slot, a further channel (17, 117) being defined on the proximal side of the slot and communicating with the slot, said thread-carrying means (5, 105) being slidably received therein for movement between said retracted position, in which the thread-carrying meals is substantially wholly within said further channel, and said extended position, in which the thread-carrying means extends across said slot (2, 102) into said compartment (10, 110).

6. A machine according to claim 5, wherein control means (15, 115) for controlling the catching means extend through the suction-supplying channel (18, 118) and across said slot (2, 102) into said compartment (10, 110) to connect with the catching means (11, 14; 111).

7. A machine according to claim 6, wherein said control means (15, 115) comprises a flexible wire, and wherein the machine further comprises a further flexible wire (6, 106) for moving the thread-carrying means (5, 105) between the retracted and extended positions.

8. A machine according to claim 6 or 7, wherein the catching means comprises a shoe (11) resiliently mounted in the compartment for pivotal movement about an axis transverse to the length of the block (1), and a hook (14) pivotally mounted at one end on the shoe and movable by said control means (15) between a position in which the other end thereof is in contact with the shoe and a position in which there is no such contact.

9. A machine according to claim 6 or 7, wherein the catching means comprises a pair of arms defining a U, the U-shaped member (111) being mounted in the compartment for pivotal movement about an axis transverse to the length of the block and a pair of resilient members (151) each extending from a respective one of said arms, the resilient members converging towards one another adjacent the outward ends thereof, the U-shapad member (111) being movable by said control means (115) between an outward position in which, when the thread-carrying means (105) is in its extended position both resilient members (151) are closely adjacent the thread-carrying means on the same side thereof, and an inward position in which the resilient members are located inwardly of the thread-carrying means.

10. A machine according to any of claims 5 to 9, wherein the block is formed of a plurality of disconnectible modules (A-G) located face to face, one of said modules being a module (B) defining said slot.

11. A machine according to any of claims 5 to 10, wherein proximally of the slot the block is transparent.

12. A machine according to any of claims 5 to 11, further comprising a mirror (153) located in the said slot and angled with respect to a line extending between the proximal and distal ends of the block.

13. A machine according to any preceding claim, mounted on an end of an endoscope.

Revendications

1. Machine à coudre destinée à former des points dans un substrat (16, 116), comprenant des moyens qui définissent une fente (2, 102) qui s'ouvre vers le substrat (16, 116) pour recevoir intérieurement le substrat, des moyens porte-fil (5, 105), servant à enfiler un fil (9, 109) dans le substrat contenu dans la fente, à partir d'un côté du substrat, en un premier emplacement, et pour tirer le fil du substrat sur le même côté, en un deuxième emplacement espacé du premier espacement, lesdits moyens pouvant être commandés à distance, en agissant seulement à partir dudit premier côté du substrat, caractérisée en ce qu'elle comprend des moyens (18, 118) servant à attirer une double couche du substrat repliée en U dans la fente (2, 102) par aspiration.

2. Machine selon la revendicatin 1, dans laquelle les moyens porte-fil (5, 105) sont agencés pour se déplacer d'une position rétractée à une position d'extension, mouvement dans lequel ils transportent une boucle de fil dans et à travers ladite double couche, la machine comprenant en outre des moyens (11, 14 ; 111) servant à prendre ladite boucle après qu'elle a été passée à travers ladite double couche et à retenir ladite boucle pendant que les moyens porte-fil (5, 105) sont ramenés à la position rétractée.

3. Machine selon la revendication 2, dans laquelle les moyens de prise (11, 14 ; 111) peuvent se déplacer d'une position de prise à une position dans laquelle la boucle prise est positionnée de telle manière que le mouvement suivant des moyens porte-fil (5, 105), de ladite position rétractée à ladite position d'extension, transportent une nouvelle boucle de fil à travers la boucle prise précédemment.

4. Machine selon une quelconque des revendications précédentes, comprenant un conduit (18, 118) qui communique avec ladite fente pour lui transmettre l'aspiration afin d'effectuer ladite aspiration de la double couche.

5. Machine selon la revendication 4, rattachée à la revendication 2 ou 3, comprenant un bloc (1) qui présente des extrémités distale et proximale, le bloc (1) définissant un compartiment (10, 110) adjacent à l'extrémité distale et qui renferme les moyens de prise (11, 14 ; 111), ladite fente (2, 102) étant définie dans le bloc, sur le côté proximal du compartiment, ledit conduit (18, 118) de transmission de l'aspiration étant défini dans le bloc sur le côté proximal de la fente, un autre conduit (17, 117) étant défini sur le côté proximal de la fente et communiquant avec la fente, lesdits moyens porte-fil (5, 105) étant logés coulissants dans ce conduit pour se déplacer entre ladite position rétractée, dans laquelle les moyens porte-fil sont sensiblement entièrement contenus dans ledit autre conduit, et ladite position d'extension, dans laquelle les moyens porte-fil traversent ladite fente (2, 102) pour pénétrer dans ledit compartiment (10, 110).

6. Machine selon la revendication 5, dans laquelle des moyens de commande (15, 115) servent à commander les moyens de prise passant dans le conduit (18, 118) de transmission de' l'aspiration et traversant ladite fente (2, 102) pour pénétrer dans ledit compartiment (10, 110) pour coopérer avec les moyens de prise (11, 14 ; 111).

7. Machine selon la revendication 5, dans laquelle lesdits moyens de commande (15, 115) comprennent un fil flexible, et dans laquelle la machine comprend en outre un autre fil flexible (6, 106) servant à déplacer les moyens porte-fil (5, 105) entre la position rétractée et la position d'extension.

8. Machine selon la revendication 6 ou 7, dans laquelle les moyens de prise comprennent un sabot (11) monté élastiquement dans le compartiment pour pivoter autour d'un axe transversal à la longueur du bloc (1), et un crochet (14) monté pivotant à une extrémité du sabot et qui peut être déplacé par lesdits moyens de commande (15) entre une position dans laquelle son aute extrémité est en contact avec le sabot, et une position dans laquelle ce contact n'existe pas.

9. Machine selon la revendication 6 ou 7, dans laquelle les moyens de prise comprennent deux bras formant un U, l'élément (111) en forme de U étant monté dans le compartiment pour pivoter autour d'un axe transversal à la longueur du bloc, et deux éléments élastiques (151) dont chacun fait saillie sur l'un, respectif,

desdits bras, les éléments élastiques convergeant l'un vers l'autre dans la région de leurs extrémités extérieures, l'élément en forme de U (11) pouvant être déplacé par lesdits moyens de commande (115) entre une position extérieure, dans laquelle, lorsque les moyens porte-fil (105) sont dans leur position d'extension, les deux éléments élastiques (151) sont étroitement adjacents aux moyens porte-fil du même côté de ceux-ci, et une position intérieure, dans laquelle les éléments élastiques sont placés à l'intérieur par rapport aux moyens portefil.

10. Machine selon une quelconque des revendications 5 à 9, dans laquelle le bloc est formé d'une pluralité de modules séparables (A-G) placés face à face, l'un desdits modules étant un module (B) qui définit ladite fente.

11. Machine selon une quelconque des revendications 5 à 10, dans laquelle le bloc est transparent dans la zone proximale par rapport à la fente.

12. Machine selon une quelconque des revendications 5 à 11, comprenant en outre un miroir (153) placé dans ladite fente et incliné par rapport à une ligne qui s'étend entre les extrémités proximale et distale du bloc.

13. Machine selon une quelconque des revendications précédentes, montée sur une extrémité d'un endoscope.

Patentansprüche

1. Nähmaschine zur Bildung von Stichen in einem Substrat (16, 116), mit Mitteln, die einen in Richtung auf das Substrat (16, 116) offenen Schlitz (2, 102) zur Aufnahme des Substrats darin bilden, mit Fadentragemitteln (5, 105) zum Durchführen eines Fadens (9, 109) in das Substrat in dem Schlitz von einer Seite des Substrats an einer ersten Stelle und zum Zurückziehen des Fadens von dem Substrat auf der gleichen Seite an einer zweiten Stelle mit Abstand von der ersten Stelle, wobei die Mittel fernbetätigbar nur von der einen Seite des Substrats sind, dadurch gekennzeichnet, daß sie Mittel (18, 118) zum Ziehen einer U-förmigen doppelten Lage des Substrates in den Schlitz (2, 102) durch Ansaugen aufweist.

2. Maschine nach Anspruch 1, bei der das Fadentragemittel (5, 105) zur Bewegung aus einer zurückgezogenen Position in eine gestreckte Position angeordnet ist, bei welcher Bewegung es eine Fadenschleife in und durch die doppelte Lage trägt, und wobei sie weiterhin Mittel (11, 14; 111) zum Fangen der Schleife, nachdem sie durch die doppelte Lage hindurchgegangen ist, und zum Halten der Schleife aufweist, während das Fadentragemittel (5, 105) in die zurückgezogene Position zurückgezogen wird.

3. Maschine nach Anspruch 2, bei der die Fangmittel (11, 14; 111) aus einer Fangposition in eine Position bewegbar sind, in der die gefangene Schleife derart positioniert ist, daß eine anschließende Bewegung des Fadentragemittels (5, 105) aus der zurückgezogenen Position in die ausgestreckte Position eine weitere Fadenschleife durch die vorher gefangene Schleife trägt.

4. Maschine nach einem vorhergehenden Anspruch, enthaltend einen mit dem Schlitz in Verbindung stehenden Kanal (18, 118) zur Lieferung des Ansaugens an diesen zur Bewirkung des Einziehens der doppelten Lage.

5. Maschine nach Anspruch 4, sofern von Anspruch 2 oder 3 abhängig, mit einem Block (1) mit einem distalen und proximalen Ende, der ein Abteil (10, 110) benachbart dem distalen Ende und die Fangmittel (11, 14; 111) beherbergend bildet, wobei der Schlitz (2, 102) in dem Block an der proximalen Seite des Abteils gebildet ist, der Ansauglieferungskanal (18, 118) in dem Block an der proximalen Seite des Schlitzes gebildet ist, ein weiterer Kanal (17, 117) an der proximalen Seite des Schlitzes und mit dem Schlitz in Verbindung stehend gebildet ist, wobei das Fadentragemittel (5, 105) gleitend darin aufgenommen ist zur Bewegung zwischen der zurückgezogenen Position, in der das Fadentragemittel im wesentlichen vollständig innerhalb des weiteren Kanals ist, und der ausgestreckten Position, in der das Fadentragemittel sich durch den Schlitz (2, 102) in das Abteil (10, 110) erstreckt.

6. Maschine nach Anspruch 5, bei der Steuermittel (15, 115) zur Steuerung der Fangmittel sich durch den Ansauglieferungskanal (18, 118) und quer durch den Schlitz (2, 102) in das Abteil (10, 110) zur Verbindung mit den Fangmitteln (11, 14; 111) erstrecken.

7. Maschine nach Anspruch 6, bei der die Steuermittel (15, 115) einen flexiblen Draht enthalten und die Maschine weiterhin einen weiteren flexiblen Draht (6, 106) zur Bewegung der Fadentragemittel (5, 105) zwischen der zurückgezo-

genen und der ausgefahrenen Position enthält.

8. Maschine nach Anspruch 6 oder 7, bei der die Fangmittel einen nachgiebig in dem Abteil zur Schwenkbewegung um eine quer zur Länge des Blockes (1) verlaufende Achse angeordneten Schuh (11) umfassen sowie einen an einem Ende an dem Schuh schwenkbar befestigten und von den Steuermitteln (15) zwischen einer Position, in der sein anderes Ende in Kontakt mit dem Schuh, und einer Position, in der es keinen solchen Kontakt gibt, bewegbaren Haken (14) enthält.

9. Maschine nach Anspruch 6 oder 7, bei der die Fangmittel ein Paar von ein U bildenden Armen enthalten, das U-förmige Element (111) in dem Abteil zur Schwenkbewegung um eine Achse quer zur Länge des Blocks angeordnet ist sowie ein Paar von nachgiebigen Elementen (151), das sich jeweils von einem der Arme erstreckt, die nachgiebigen Elemente aufeinanderzu im Bereich ihrer äußeren Enden konvergieren, das U-förmige Element (111) von den Steuermitteln (115) zwischen einer äußeren Position, in der, wenn das Fadentragemittel (105) in seiner ausgestreckten Position ist, beide nachgiebigen Elemente (151) eng benachbart zu dem Fadentragemittel auf der gleichen Seite von diesem sind, und einer inneren Position bewegbar ist, in der die nachgiebigen Elemente innerhalb der Fadentragemittel angeordnet sind.

10. Maschine nach einem der Ansprüche 5 bis 9, bei der der Block aus einer Vielzahl von voneinander lösbaren Modulen (A-G) gebildet ist, die Seite an Seite angeordnet ist, wobei eines der Module ein Modul (B) ist, das den Schlitz bildet.

11. Maschine nach einem der Ansprüche 5 bis 10, bei dem der Block auf der proximalen Seite des Schlitzes transparent ist.

12. Maschine nach einem der Ansprüche 5 bis 11, weiterhin enthaltend einen in dem Schlitz angeordneten Spiegel (153), der unter einem Winkel gegenüber einer Linie verläuft, die sich zwischen dem proximalen und dem distalen Ende des Blockes erstreckt.

13. Maschine nach einem vorhergehenden Anspruch, befestigt an einem Ende eines Endoskops.

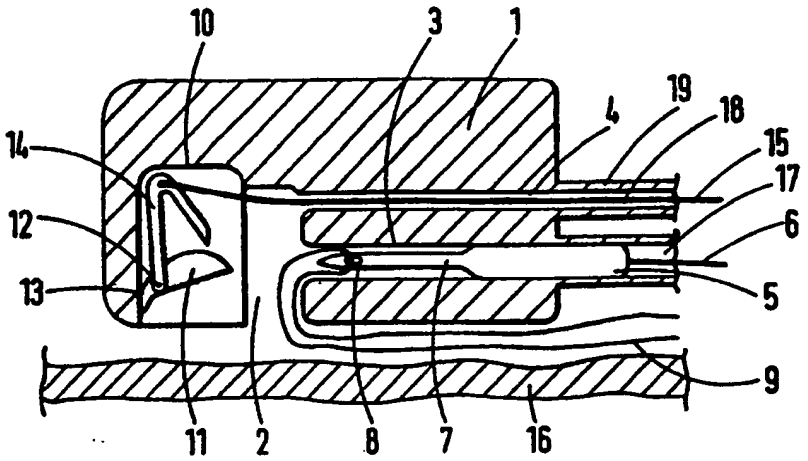


Fig.1a

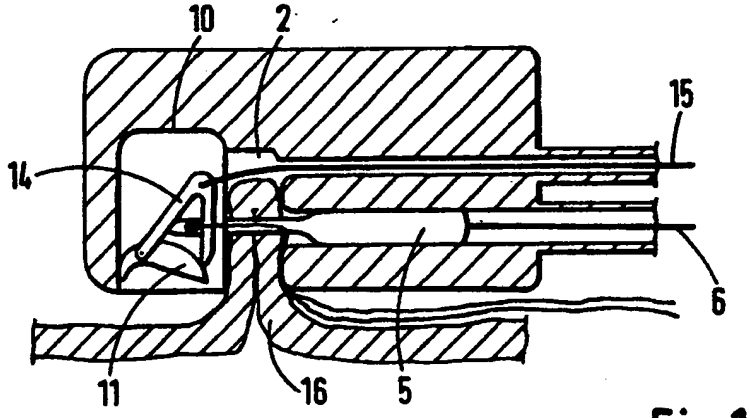


Fig.1b

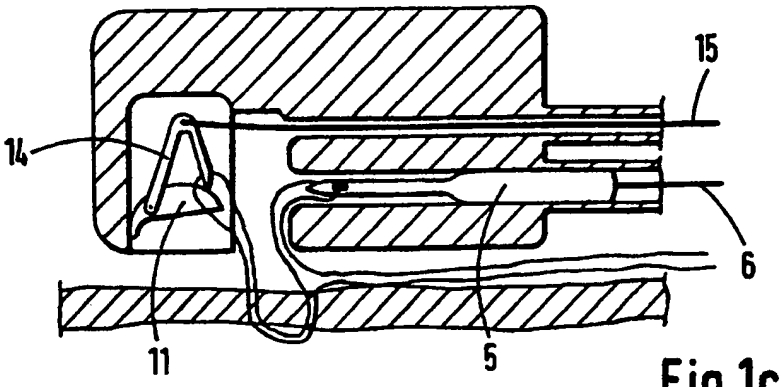


Fig.1c

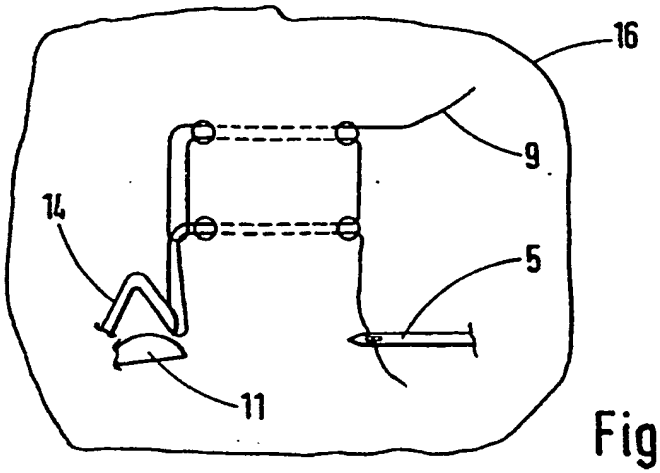


Fig.2

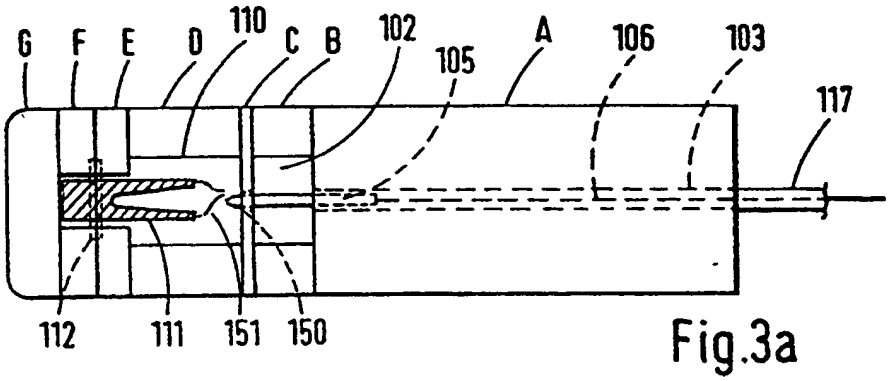


Fig.3a

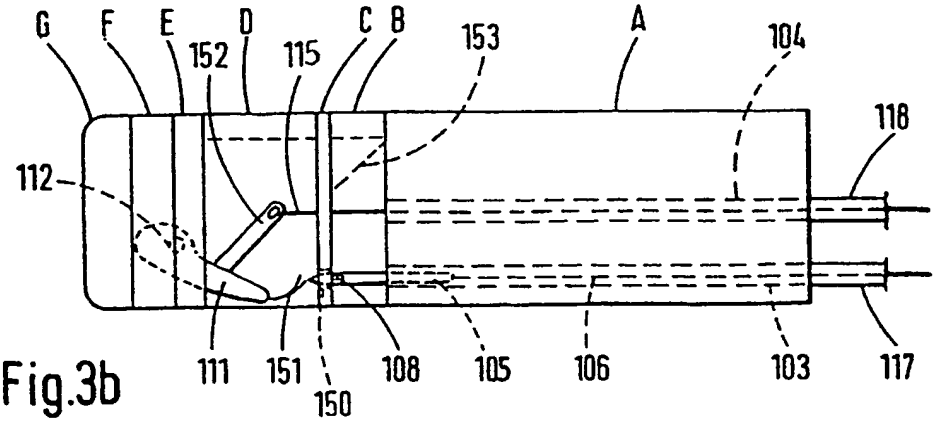


Fig.3b

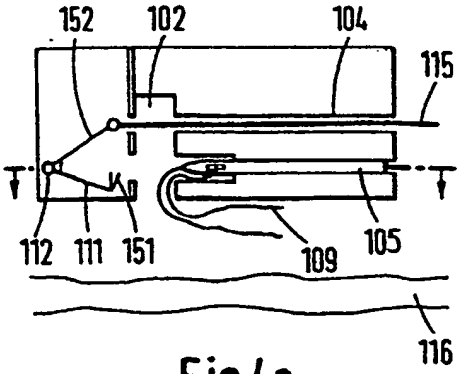


Fig.4a

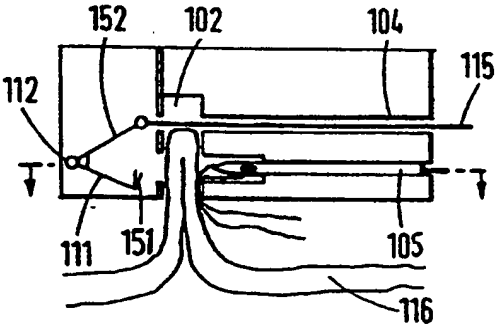
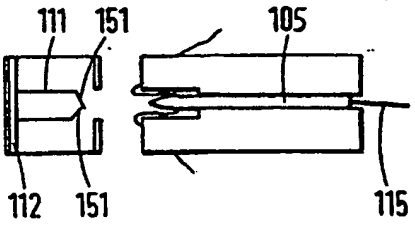
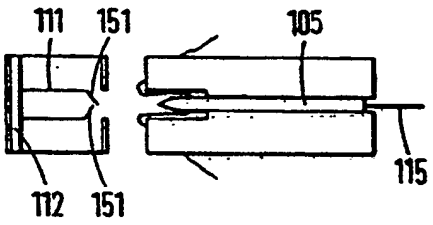


Fig.4b





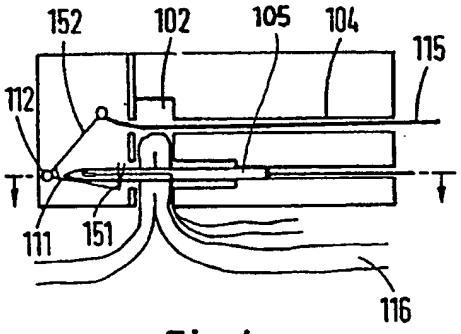


Fig.4c

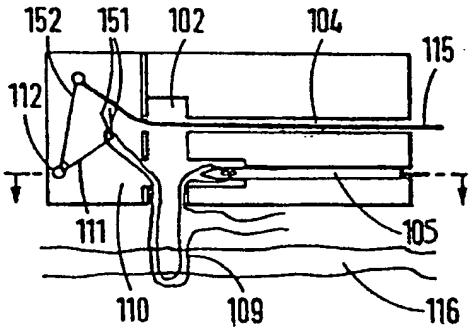
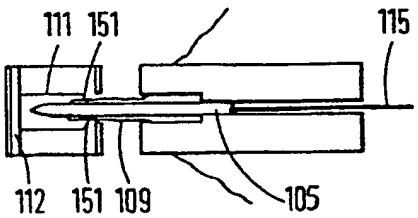
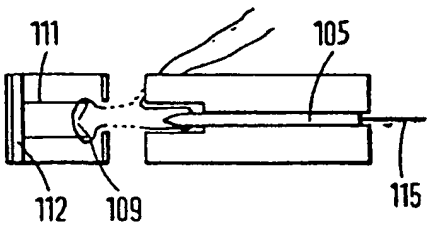


Fig.4d





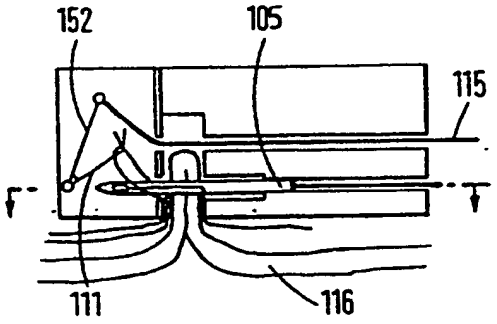


Fig.4e

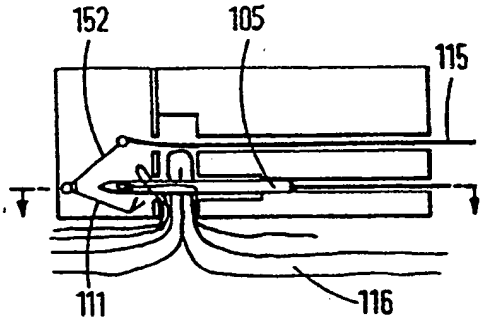
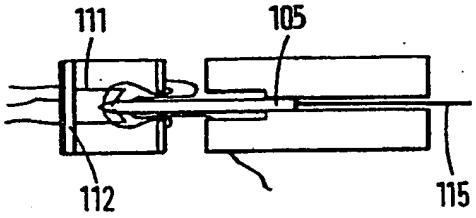
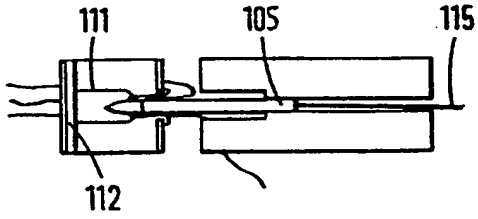


Fig.4f





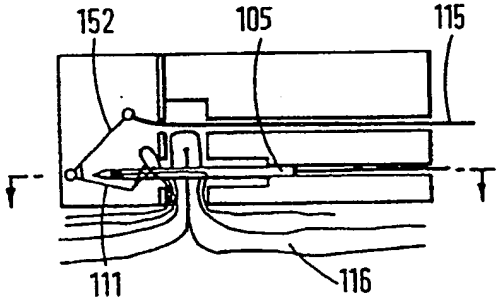


Fig.4g

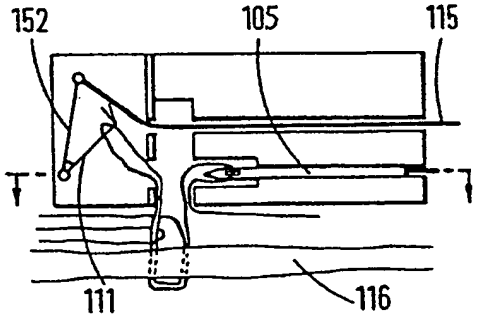
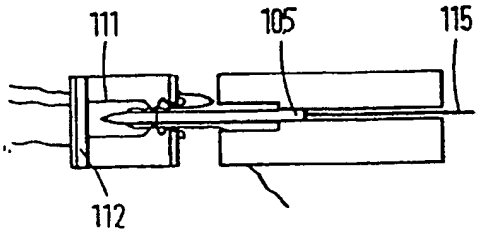
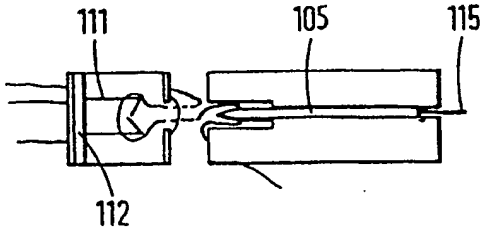


Fig.4h





(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 174 843**
A3

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 85306453.3

(22) Date of filing: 11.09.85

(51) Int. Cl.⁴: A 61 B 17/04
A 61 B 17/10, A 61 B 17/32

(30) Priority: 11.09.84 GB 8422863

(43) Date of publication of application:
19.03.86 Bulletin 86/12

(88) Date of deferred publication of search report: 13.07.88

(84) Designated Contracting States:
CH DE FR GB LI NL SE

(71) Applicant: UNIVERSITY COLLEGE LONDON
Gower Street
London WC1E 6BT(GB)

(72) Inventor: Mills, Timothy Noel
Flat 4 45 Newman Street
London W.1.(GB)

(72) Inventor: Swain, Christopher Paul
52 Gloucester Avenue
London NW1 8JD(GB)

(74) Representative: Boon, Graham Anthony et al,
Elkington and Fife High Holborn House 52/54 High Holborn
London, WC1V 6SH(GB)

(54) Sewing or stapling machine.

(57) A sewing machine for forming stitches in a substrate (16, 116), for example in forming stitches in tissue during surgery, comprises a needle (6; 106; 20, 30) for passing thread (9, 109, 24) into the substrate from one side thereof at a first location and for withdrawing the thread from the substrate at a second location spaced from the first location. The needle is removably operable solely from the said one side of the substrate. A stapling machine is also disclosed operating on similar principles for similar purposes.

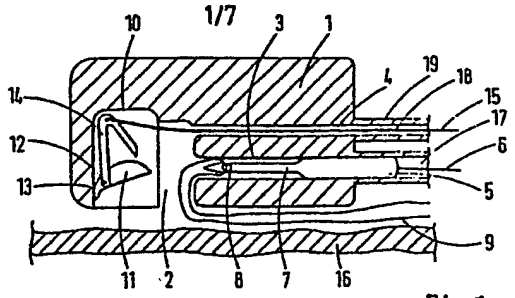


Fig.1a

EP 0 174 843 A3

European Patent Office

EUROPEAN SEARCH REPORT

0174843

Application number
EP 85 30 6453

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	CH - A - 645 012 (JANOME SEWING MACHINE CO.) * Page 2, lines 34-57; page 3, column 1, line 20 - column 2, line 10; claim 1; figures 1,5-12 *	1	A 61 B 17/04 A 61 B 17/10 A 61 B 17/32
A	--	3	
X	US - A - 4 417 532 (JANOME SAWING MACHINE INDUSTRY CO.) * Column 2, line 48 - column 3, line 12; claim 1; figures 1,5, 11-14 *	1	
A	--	3	
X	GB - A - 2 050 448 (JANOME SEWING MACHINE CO.) * Page 3, lines 50-91; claim 1; figures 4,39-44 *	1	
A	--	2,3	TECHNICAL FIELDS SEARCHED (Int. Cl.4)
A	DE - A - 1 685 043 (SCHWEINFURTHER) * Claims 1,2; figures 2-11 *	13-15	A 61 B 17/00 D 05 B 81/00
A	-- US - A - 2 637 290 (SIGODA) * Claims 1,5,6; figures 1,7-9 *	13-15	
A	-- US - A - 4 235 238 (OGIU et al.) * Column 3, lines 39-50; claims 1,3; figure 1 *	7,16	

Place of search	Date of completion of the search	Examiner
THE HAGUE	02-11-1987	MONNÉ

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503 03 82

European Patent Office

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid,

namely claims:

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

X LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions,
namely:

1. Claims 1-16: Sewing machine
2. Claims 17-20: Stapling machine
3. Claims 21,22: Guillotine

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid,

namely claims:

☒ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims,

namely claims: 1-16

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 174 843**
A2

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 85306453.3

(22) Date of filing: 11.09.85

(51) Int. Cl.⁴: A 61 B 17/04
A 61 B 17/10, A 61 B 17/32

(30) Priority: 11.09.84 GB 8422863

(43) Date of publication of application:
19.03.86 Bulletin 86/12

(84) Designated Contracting States:
CH DE FR GB LI NL SE

(71) Applicant: UNIVERSITY COLLEGE LONDON
Gower Street
London WC1E 6BT(GB)

(72) Inventor: Mills, Timothy Noel
Flat 4 45 Newman Street
London W.1.(GB)

(72) Inventor: Swain, Christopher Paul
52 Gloucester Avenue
London NW1 8JD(GB)

(74) Representative: Boon, Graham Anthony et al,
Elkington and Fife High Holborn House 52/54 High Holborn
London, WC1V 6SH(GB)

(54) **Sewing or stapling machine.**

(57) A sewing machine for forming stitches in a substrate (16, 116), for example in forming stitches in tissue during surgery, comprises a needle (6; 106; 20, 30) for passing thread (9,109,24) into the substrate from one side thereof at a first location and for withdrawing the thread from the substrate at a second location spaced from the first location. The needle is removably operable solely from the said one side of the substrate. A stapling machine is also disclosed operating on similar principles for similar purposes.

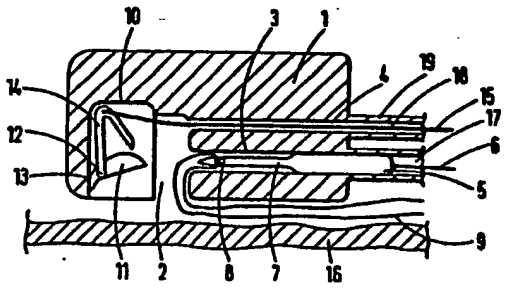


Fig.1a

EP 0 174 843 A2

Sewing or Stapling Machine

This invention relates to sewing machines and stapling machines. The invention has particular application to sewing required in surgical procedures, and, more particularly, relates to sewing and stapling machines which can be used inside the body of a patient without the need to make an external incision in the patient, the machine being controlled externally of the patient, for example by endoscopic means. For convenience such a machine is referred to below as an endoscopic sewing or stapling machine, and the ensuing description relates largely to endoscopic sewing and stapling machines. It is to be understood, however, that sewing and stapling machines according to the present invention could be used in other applications.

According to one aspect of the present invention there is provided a sewing machine for forming stitches in a substrate, comprising means for passing a thread into the substrate from one side thereof at a first location and for withdrawing the thread from the substrate at a second location spaced from the first location, the said means being remotely operable solely from the said one side of the substrate.

According to another aspect of the invention there is provided a stapling machine operating on similar principles. The machines according to the present invention open up the possibility of performing a wide range of internal surgical procedures without having to make an external incision in the patient. Potential medical uses of such machines could include the oversewing of bleeding or perforated ulcers, the oversewing of bleeding varices, the narrowing of lax internal anatomical sphincters or organs, the closure of internal holes or fistulae, the assistance in the removal of normal or abnormal tissue, and the attachment of materials or objects to the walls of tissue (for example for attaching gastric tubes for feeding purposes to the wall of the stomach, or for attaching X-ray opaque markers to mark the site of, say, a cancer, or for attaching a piece of material containing a drug to permit localised internal treatment).

Figures 1a, 1b and 1c show a first embodiment of a sewing machine according to the present invention, in three successive stages of operation;

Figure 2 shows, by way of example, one stitch pattern which can be formed by the machine of Figures 1a to 1c;

Figures 3a and 3b are underplan and side elevational views respectively showing a second embodiment of a sewing machine;

Figures 4a to 4h show diagrammatically the second embodiment of sewing machine in successive stages of operation, each Figure comprising two longitudinal sections through mutually perpendicular planes, in order to enable the operation of the machine to be more easily visualised in three dimensions, one of the longitudinal sections in each Figure being taken along the section line indicated in the other;

Figures 5a to 5c show longitudinal sections through an embodiment of stapling machine according to the present invention, in successive stages of operation;

Figures 6a to 6f show a third embodiment of the present invention in successive stages of operation; and

Figures 7a to 7c are, respectively, a plan view, a vertical section and an end view of a thread guillotine for use in conjunction with the sewing machine of the present invention.

The embodiment shown in Figures 1a to 1c comprises a block 1 preferably formed of a transparent material such

such as perspex. A slot 2 is formed in the block 1, the slot extending from the front to the back of the block, i.e. in a direction perpendicular to the plane of the paper. The block also has two longitudinal channels 3 and 4 formed therein. The channel 3 receives a needle 5 which is longitudinally slidable in the channel 3 under the control of a control wire 6. The needle 6 has a head portion 7 in which is formed an eye 8, and a thread 9 to be used in sewing is passed through the eye 8. The channels 3 and 4 are continuous with corresponding channels 17 and 18 formed in a two-channel endoscope tube 19.

The block 1 also has a compartment 10 formed therein, distal to the slot 2. A shoe 11 is pivotally mounted in the compartment 10 about a pin 12. The rear portion 13 of the shoe 11 is resilient and serves to bias the shoe in an anti-clockwise direction into the position shown in Figure 1a. A hook 14 is mounted for pivotal movement on the pin 12. The hook 14 is approximately in the shape of a V, and a control wire 15, which passes down the channels 4 and 18, is attached to the hook 14 adjacent the vertex of the V. A source of suction (not shown) is connected to the proximal end of channel 18 for a purpose which will be described below.

Turning now to the operation of the machine, the initial position is shown in Figure 1a, with the machine

positioned above a layer of tissue 16 in which it is desired to form stitches. Suction is then applied to the slot 2 to suck into the slot a double layer of tissue, as can be seen in Figure 1b. The depth of the slot 2 controls the amount of tissue which is sucked in. The needle 5 is then forced forwards through the double layer of tissue, as is also shown in Figure 1b. The needle carries with it the loop of thread 9. The tip of the needle strikes the shoe 11 which is thereby caused to pivot downwardly against the biassing force of the shoe portion 13. The control wire 15 is then pulled rightwardly to cause the hook 14 to pivot and thereby catch the loop of thread carried by the eye 8 of the needle 5. This can also be seen in Figure 1b. It should be mentioned at this point that the side of the head portion 7 of the needle has a groove (not shown) formed therein to allow the hook 14 to pass between the head portion 7 and the thread carried thereby.

As shown in Figure 1c the needle is then withdrawn leaving the loop of thread held between the hook 14 and the shoe 11. The suction applied to the slot 2 is then released and the double layer of tissue leaves the slot. This is also shown in Figure 1c, from which it can be seen that the effect of the steps described above is to pass a loop of thread from one side of the tissue through the

tissue at a first location and back out of the tissue on the same side at a second location from the first location. As will be appreciated, this has been done without requiring access to the opposite side of the tissue which one would expect to be inaccessible under normal circumstances.

The machine is then moved to the site of the next stitch, suction is re-applied and the needle passes through a double layer of tissue at a different point. It is possible to form a variety of different stitches using the machine, but one example is shown diagrammatically in Figure 2. This stitch pattern is formed by moving the machine between successive stitches in a direction perpendicular to the plane of the paper in the drawings of Figure 1a to 1c. Figure 2 is a view taken looking down on the upper surface of the tissue shown in Figures 1a to 1c, and it will be seen that each of the loops formed by the hook 14 and the shoe 11 passes through the preceding such loop. How this is achieved can be understood by imagining the effect of moving the needle forwardly from the position shown in Figure 1c, with suction re-applied to the slot 2 to suck the tissue into the slot. It will be appreciated that the forward end of the needle will pass through the loop of thread caught between the hook 14 and the shoe 11, carrying a new loop of thread with it. It should be mentioned that to assist this process a small groove can be formed in the upper surface of the shoe, up

which the tip of the needle can slide. This enables the needle to pass under the loop of thread already caught between the hook and shoe, without the risk that the needle may simply push the existing loop further up the surface of the shoe. Once the needle has placed the second loop through the first loop the hook 14 is pivoted to allow the first loop to be cast off by pulling on the tail of the thread. The hook 14 is then pivoted downwardly again, so that when the needle is withdrawn the second loop of thead is caught thereby.

As already mentioned, the body 1 is preferably made of a transparent material, so as to make it easier for the operator to see, and hence control, the operation of the machine. The control mechanisms can pass down the channel of an existing endoscope, or the machine can be used independently with a small supervising endoscope passed in parallel with the control channel of the machine.

The embodiment shown in Figures 3a and 3b is modular in construction, and comprises modules A to G joined face to face and held in position by suitable means, for example, a pair of longitudinally extending bolts passing through aligned bores in the individual modules. In the embodiment illustrated the modules B and D are formed of a transparent material and the remaining modules are not, but others of the modules may be transparent, and indeed it is preferable for some purposes that at least the module A should be transparent.

The module A is the main body portion, and defines longitudinal channels 103 and 104, corresponding to the channels 3 and 4 shown in Figure 1. The channel 103 receives a needle 105, which is longitudinally slidable therein under the control of a control wire 106. The needle 106 has a head portion in which is formed an eye 108 and a thread to be used in sewing is passed through the eye. The channels 103 and 104 are continuous with corresponding channels 117 and 118 formed in a two-channel endoscope tube, the rest of the endoscope being omitted for simplicity in Figures 3a and 3b.

The module B has a slot 102 formed therein, which, as viewed in underplan view, extends across the central region of the module B and which, as viewed in elevation, extends from the top of the module to a location falling just short of the bottom.

The module B is separated by module C, which constitutes a spacer disc and which has an aperture 150 therein through which the needle 105 can pass, from the module D. Module D has a compartment 110 therein which is aligned with slot 102 in module B.

Modules E and F retain a pin 112 on which a U-shaped member 111 is pivotally mounted. The arms of the member 111 each carry a respective resilient wire 151. As can be seen in Figure 3, the wires converge towards one another at their tips as viewed in underplan, and, as can be seen in Figure 3b, the tip portions of the wires are bent upwardly

and one of the wires is longer than the other and thus extends further upwards than does the other.

A control wire 115, which passes down the channels 118 and 104 is attached to an arm 152 which is, in turn, rigidly connected to the U-shaped member 111.

The module G provides a curved or bevelled front end to the device, so as to increase the ease with which it can be introduced into a patient.

A source of suction (not shown) is connected to the proximal end of the channel 118 for a purpose which will be described in more detail below and which is basically similar to that for which the source of suction is used in the embodiment of Figure 1.

The operation of the device of Figures 3a and 3b will now be described with reference to Figures 4a to 4h. It should be noted that these figures are diagrammatic in character. In each case module G has been omitted, and the modular construction of the remaining portion of the device has not been shown in detail.

The initial position is shown in Figure 4a with the machine positioned above a layer of tissue 116 in which it is desired to form stitches. Suction is then applied to the slot 102 via the channel 104 to suck into the slot a double layer of tissue, as can be seen in Figure 4b. The depth and width of the slot 102 controls the amount of tissue which is sucked in. The modular design of this embodiment makes it possible to vary the amount of tissue

sucked in, and hence vary the size of the stitches, simply by removing module B and replacing it by a module having a different thickness of depth of slot.

The needle 105 is then forced forwards through the double layer of tissue, as shown in Figure 4c. The needle carries with it a loop of a thread 109. The needle passes in front of the upwardly extending tip portions of both of the wires 151, as viewed in Figure 4c. The control wire 115 is then pushed leftwards, as shown in Figure 4c, to cause the U-shaped member 111 to pivot anti-clockwise and thus to cause the wires 151 to catch the loop of thread carried by the eye of the needle 105. The needle 105 is then withdrawn rightwards whilst the U-shaped member is rotated fully anti-clockwise carrying the thread upwards into the compartment 110. This is shown in Figure 4d. This last action forms the thread into a large diameter loop. This results from the fact that the wires 151 diverge from one another as considered in a direction running leftwardly from their tips.

The suction applied to the slot 102 is then released and the double layer of tissue, with the thread 109 passing through it, leaves the slot. This is also shown in Figure 4d.

The machine is then moved with respect to the tissue in any direction to the right of a plane drawn perpendicular to the plane of the paper and passing through the machine.

Thus, the machine could be moved rightwardly in a direction parallel to its length, or at any angle less than 90° with respect to the aforesaid direction. The step shown in Figure 4e is then carried out, that is to say, suction is re-applied and the needle caused to pass through a double layer of tissue at a different point to that where the needle passed through the tissue in step 4c. As can be seen in Figure 4e, the forward end of the needle passes through the loop of thread already held by the U-shaped member 111, carrying a second loop of thread with it. Once the needle has placed this second loop through the first loop, the U-shaped member is pivoted clockwise, as shown in Figure 4f. The wires 151, being resilient, are forced apart by the needle and thus pass one on either side of the needle as the U-shaped member 111 travels to the position shown in Figure 4f, in which it is below the needle. In so doing the wires 151 drop the first loop onto the second loop.

The member 111 is then pivoted anti-clockwise, as shown in Figure 4g, so as to catch the second loop carried by the eye of the needle. This is shown in Figure 4g. Both wires 151 at this stage lie against the needle 102 and between the needle 102 and the adjacent portion of the thread 109.

As shown in Figure 4h, the needle 102 is then withdrawn rightwardly and the member 112 is pivoted further in an anti-clockwise direction, carrying the second loop upwards

with it. As also shown in Figure 4h, the suction is then released to allow the tissue to leave the slot 102.

The above procedure is repeated as many times as are necessary in order to produce the desired number of stitches.

Various modifications may be made to the embodiments described above. One of these is that the machine can be provided with a plurality of slots 2 into each of which a double layer of tissue may be sucked. A single needle can then pass through each of these double layers of tissue, thus making a plurality of stitches in a single operation. Also, it should be understood that the stich forming part of the machine could be modified to correspond to that of any one of a number of conventional sewing machines. For example, the stitching mechanism could be one which uses two threads, rather than one as in the illustrated embodiments.

As mentioned above, the module A is preferably transparent. This is to make it easier for the operator to see, and hence control the operation of the machine. Visibility may further be improved, both in the embodiment of Figures 3 and 4 and in the embodiment of figure 1, by positioning a mirror in the slot 102 (or slot 2) at 45° to the longitudinal axis of the machine. By way of example this is shown diagrammatically as 153 in Figure 3b. This enables the user to see the double layer of tissue sucked into the slot 2. A still further improvement can be achieved by extending the endoscope optics right up to the slot 102 (or 2).

Some of the principles utilised in the above sewing machines can be applied with similar effect to the construction of a stapling machine which can also be used in a surgical environment. An embodiment of such a stapling machine is shown in figures 5a to 5c, which show successive steps in its operation.

The stapling machine comprises a body 200 which, if desired, may be of modular construction. The body is preferably wholly or partially of a transparent material. The body defines a cavity 202 into which tissue 216 may be sucked by suction applied through a suction channel 204. Before use, the cavity 202 is pre-loaded with a staple 209. The body also contains a second channel 203 through which extends a wire 206 carrying a piston 205 at its end. The cavity 202 has, in one wall thereof, an anvil plate 260, for a purpose which is described below.

In the starting condition shown in Figure 5a, the staple 209 comprises four consecutive rectilinear sections, namely a first upwardly extending section, a second horizontally extending section, a third diagonally downwardly extending section, and a fourth section, which is parallel to the second section, and has its free end directed towards the first section. In the condition shown in Figure 5a suction has been applied to the channel 204 to suck into it a double layer of tissue 216. As shown in Figure 5b the next step is for the piston 205 to be moved leftwardly by means of the wire 206, thus driving the fourth sections

of the staple through the double layer of tissue so that its tip comes into contact with the anvil 260, and simultaneously deforming the remaining sections of the staple. As shown in Figure 5c, further leftward movement of the piston 206 causes the tip of the staple to ride along the anvil 206, thus twisting it around the first section of the staple and locking the staple so that it exerts a compressive force on the tissue held by it. The illustrated embodiment shows only a single staple. However, the machine may carry a plurality of staples connected side by side as in the case of staples used, for example, in stationery applications. In this case, the row of staples is biassed, for example, by a spring exerting a force perpendicular to the plane of the paper as viewed in figure 5, a stop being provided to retain the row of staples in the correct position against the biassing force.

Figures 6a to 6f show, in part, a further embodiment of a sewing machine according to the present invention. The construction of this embodiment will become apparent from the following description of how it operates. The machine comprises two needles 20 and 30. Before the stage shown in Fugure 6a, the needles are withdrawn such that their tips are separated by about 5mm. Then, as shown in Figure 6a, the first needle 20 is passed obliquely through the tissue 16, as indicated by the arrow. The needle 20 has a pair of opposed barbs 21 separated by a

slot 22. The slot 22 provides access to an opening 23. A loop of thread 24 is carried forwardly by the needle. The tissue 16 is held in place by suction applied to a tube 25, the distal end of which carries the sewing machine of which the needle 20 forms a part. Only the end of the tube 25 is visible in the figures. The proximal end of the needle 20 is guided for rectilinear movement in a bush (not shown).

As shown in Figure 6b, once the needle 20 has been passed through the tissue to the full extent which is required an identical needle 30 is inserted through the tissue at a location remote from that at which the needle 20 passed through the tissue. The needle 30 is angled oppositely to the needle 20 so that, as shown in Figure 6b, its path of travel intersects that of the needle 20. At this stage the needle 30 carries no thread. Furthermore, the needle 30 is rotated by 90° about its longitudinal axis compared to the needle 20. The needle 30 has a slot 32, corresponding to slot 22 of needle 20, and barbs 31, corresponding to barbs 21 of needle 20. As shown in Figure 6b, the needle 30 passes between the needle 20 and the loop of thread 24 carried by the needle 20. To assist in this the needle 20 is provided with a depression 26 which is obscured in Figure 6 but which can be seen in Figure 6c.

In the position illustrated in Figure 6b, the slot 32 is located immediately below the thread 24. This causes

the thread 24 to pass through the slot 32 and thus causes it to be caught by the needle 30.

As shown in Figure 5c, the needle 30 is then partially withdrawn, and as it does so it pulls the loop of thread 24 with it. As shown in Figure 5d, when the needle 20 is then partially withdrawn the thread 24 is freed from the needle 20 and held only by the needle 30. Further withdrawal of both needles 20 and 30 to a position where both pass out of the tissue 16 causes the situation to be reached which is shown in Figure 6e where a stitch has been formed.

Each of the needles 20 and 30 is then rotated by 90° about its own axis, so that needle 20 assumes the orientation and function which was previously that of needle 30 and needle 30 assumes the orientation and function which was previously that of needle 20. The above described process is then repeated with the functions of the needles 20 and 30 interchanged. This procedure is continued as many times as are necessary to produce the required number of stitches.

The use of an endoscopic sewing machine according to the present invention gives rise to a requirement for a suitable means for securing knots and cutting thread. Secure knots are essential for surgery, and tying knots and cutting thread by remote control in confined spaces, as is necessary in conjunction with the use of the

endoscopic sewing machines described above, imposes special requirements. Some ways of satisfying these requirements are therefore mentioned below.

One method of tying a knot is as follows. A washer having a central hole, the diameter of which is a clearance fit on the thread to be fastened is fed onto the thread. The thread is tied as a half-hitch around a pin pressed through the two walls of the end of a strong but flexible catheter tube. By holding the tail of the thread and pushing on the tube the half-hitch and washer in front of it may be run forward. When the desired position has been reached, the pin is removed remotely by pulling on a wire to which it is attached and which runs along the outside of the catheter. In another method of fastening the thread, a plastic washer is run over the thread down the endoscope channel. Plastic is preferred to metal because it is resistant to acid digestion. A compressible tapered sleeve is passed over the thread and a rammer bears down on the sleeve, distorting it tightly over the thread and against the washer while pull is exerted on the thread. Yet another method of fastening the thread uses a Z-shaped plastic strip having holes for the thread in the three limps of the Z-shape. There is a V-shaped slit cut in the proximal hole. The thread is run through all the three holes of the Z-shaped strip which is pushed through the endoscope channel. A pushing device compresses and

folds the Z-shaped strip like a flattened concertina against the tissue. This tightens on the thread forcing it into the narrow V-shaped slit which holds the thread securely.

Figure 7 shows a thread guillotine for endoscopic use. This comprises a crooked leg 40 with a slit 41 cut centrally along its length at one end thereof. The leg 40 is formed on the end of a metal tube 42 which is pressed over the end of a small diameter plastic catheter tube 43. A knife blade 44 is held in a piston 45 which is free to move axially in the bore of the tube 43. A wire 46 attached to the piston 45 and running through the bore of the tube 43 controls the movement of the blade when pushed forward. The blade 44 passes through the slot 41 in the crooked leg, thereby acting as a guillotine to sever the thread 47.

Finally, mention may be made of a suction overtube to facilitate sewing down an endoscope by means of a machine according to the present invention, or indeed by some other means. The overtube envisaged is a transparent flexible tube which fits loosely over the endoscope. An air-tight seal is made with an elastic sleeve between the overtube and the endoscope. A hole of specific dimensions is cut in the extreme end or in the side of the overtube distally. Air is sucked from the overtube such that tissue to be sewed protrudes into the overtube where it is

held in a conformation which enables the tissue to be readily transfixed by a threaded needle.

It is to be understood that the various devices described above as being ancillary to the sewing machine according to the present invention are believed to be novel in their own right and form independent aspects of the present invention.

CLAIMS:

1. A sewing machine for forming stitches in a substrate, comprising thread-carrying means for passing a thread into the substrate from one side thereof at a first location and for withdrawing the thread from the substrate at a second location spaced from the first location, the said means being remotely operable solely from the said one side of the substrate.

2. A machine according to claim 1, comprising means defining a slot open towards the substrate, and means for drawing a double layer of the substrate into the slot, the thread-carrying means being disposed for movement from a retracted position to an extended position, in which movement it carries a loop of the thread into and through the said double layer, and further comprising means for catching the said loop after it has been passed through the double layer of substrate and holding the said loop while the thread-carrying means is withdrawn to the retracted position.

3. A machine according to claim 2, wherein the catching means is movable from a catching position to a position in which the loop caught thereby is positioned so that subsequent movement of the thread-carrying means from said retracted position to said extended position carries a further loop of thread through the previously caught loop.

4. A machine according to claim 2 or 3, comprising a channel communicating with said slot for supplying suction thereto to effect the said drawing in of the double layer.

5. A machine according to claim 4, comprising a block having distal and proximal ends, the block defining a compartment adjacent the distal end housing the catching means, said slot being defined in the block on the proximal side of the compartment, said suction-supplying channel being defined in the block on the proximal side of the slot, a further channel being defined on the proximal side of the slot and communicating with the slot, said thread-carrying means being slidably received therein for movement between said retracted position, in which the thread-carrying means is substantially wholly within said further channel, and said extended position, in which the thread-carrying means extends across said slot into said compartment.

6. A machine according to claim 5, wherein control means for controlling the catching means extend through the suction-supplying channel and across said slot into said compartment to connect with the catching means.

7. A machine according to claim 6, wherein said control means comprises a flexible wire, and wherein the machine

further comprises a further flexible wire for moving the thread-carrying means between the retracted and extended positions.

8. A machine according to claim 6 or 7, wherein the catching means comprises a shoe resiliently mounted in the compartment for pivotal movement about an axis transverse to the length of the block, and a hook pivotally mounted at one end on the shoe and movable by said control means between a position in which the other end thereof is in contact with the shoe and a position in which there is no such contact.

9. A machine according to claim 6 or 7, wherein the catching means comprises a pair of arms defining a U, the U-shaped member being mounted in the compartment for pivotal movement about an axis transverse to the length of the block and a pair of resilient members each extending from a respective one of said arms, the resilient members converging towards one another adjacent the outward ends thereof, the U-shaped member being movable by said control means between an outward position in which, when the thread-carrying means is in its extended position both resilient members are closely adjacent the thread-carrying means on the same side thereof, and an inward position in which the resilient members are located inwardly of the thread- carrying means.

10. A machine according to any of claims 5 to 9, wherein the block is formed of a plurality of disconnectible modules located face to face, one of said modules being a module defining said slot.

11. A machine according to any of claims 5 to 10, wherein proximally of the slot the block is transparent.

12. A machine according to any of claims 5 to 11, further comprising mirror located in the said slot and angled with respect to a line extending between the proximal and distal ends of the block.

13. A machine according to claim 1, comprising means for holding said substrate, first and second needles guided for movement along the axis thereof and arranged so that said axes intersect at a point located away from said substrate on the opposite side thereof to said one side thereof, means on each needle for holding a loop of thread and for catching the loop of thread held by the other needle.

14. A machine according to claim 13, wherein the thread-holding and thread-catching means comprises an opening formed in the needle and a slot communicating with said opening and providing access thereto.

15. A machine according to claim 14, wherein each needle is rotatable about the axis thereof between a thread-transporting position and a thread-releasing position at 90° thereto in which the other needle can remove the thread transported thereto.

16. A machine according to any preceding claim, mounted on an end of an endoscope.

17. A stapling machine for inserting a staple in a substrate, comprising means defining a slot open towards the substrate, the slot being configured to receive at least one staple having opposite end portions which are spaced from one another to define a gap therebetween, means for drawing a double layer of the substrate into the slot and through said gap, and means for forcing one of said staple end portions through the double layer of substrate.

18. A machine according to claim 17, comprising an anvil disposed in the slot adjacent the other of said staple end portions and arranged so that when said one staple end portion is driven through the double layer of substrate it strikes the anvil and is deformed thereby into a position closely adjacent said other staple end portion.

19. A machine according to claim 17 or 18, comprising a channel communicating with said slot for supplying suction thereto to effect said drawing in of the double layer.

20. A machine according to any of claims 17 to 19, mounted on an end of an endoscope.

21. A guillotine for use in severing a thread, comprising a tube, a leg extending from one end of the tube and having an inwardly directed end portion with longitudinal slot formed therein, and a blade mounted on mounting means which are arranged to move longitudinally within the tube between a forward portion in which the blade passes through said longitudinal slot and rearward position in which the blade is spaced from the longitudinal slot.

22. A guillotine according to claim 21, comprising a catheter tube, the said mounting means being arranged to slide within the catheter tube and the tube which has the said leg being fixedly mounted on the exterior of the catheter tube.

0174843

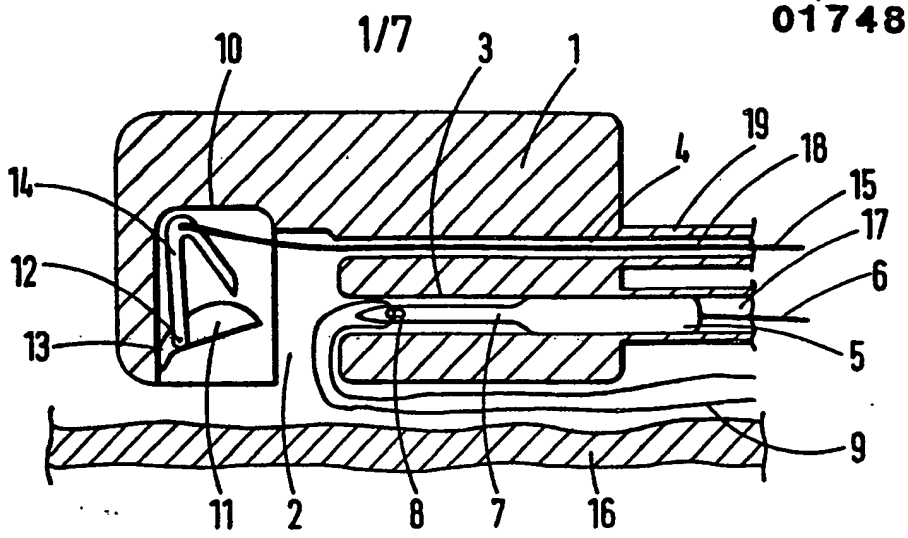


Fig.1a

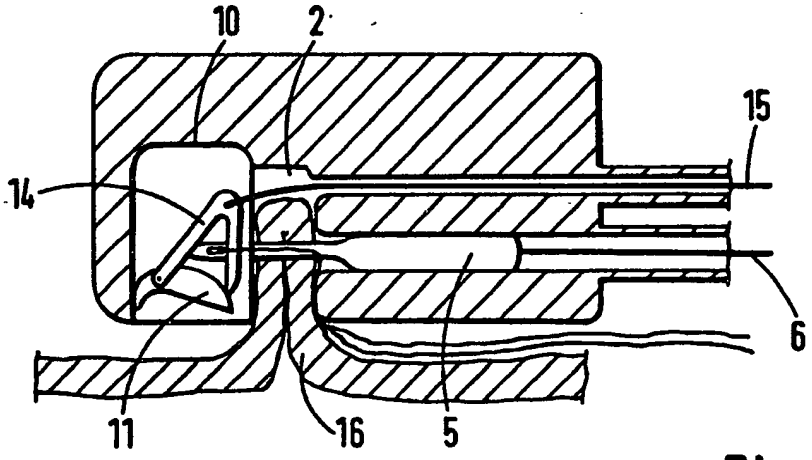


Fig.1b

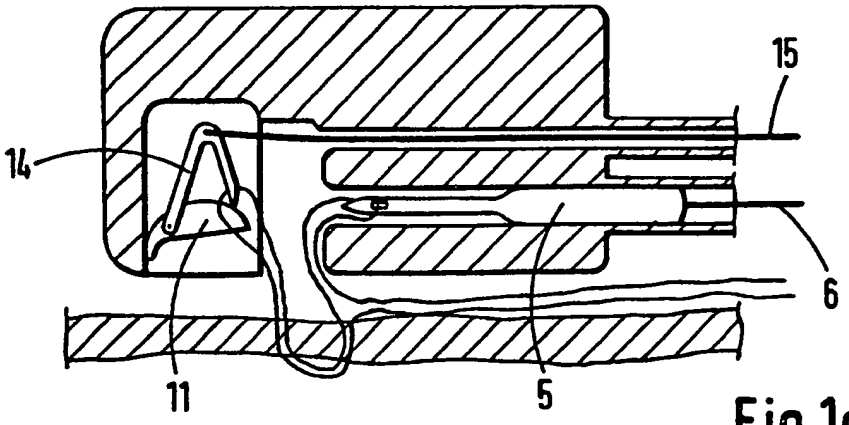


Fig.1c

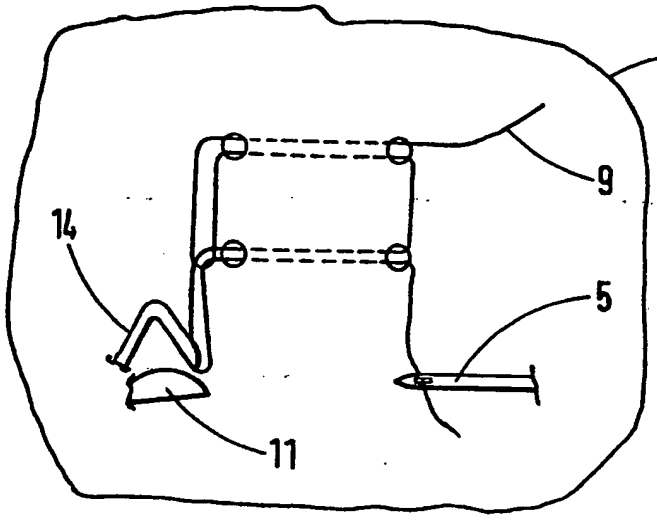


Fig.2

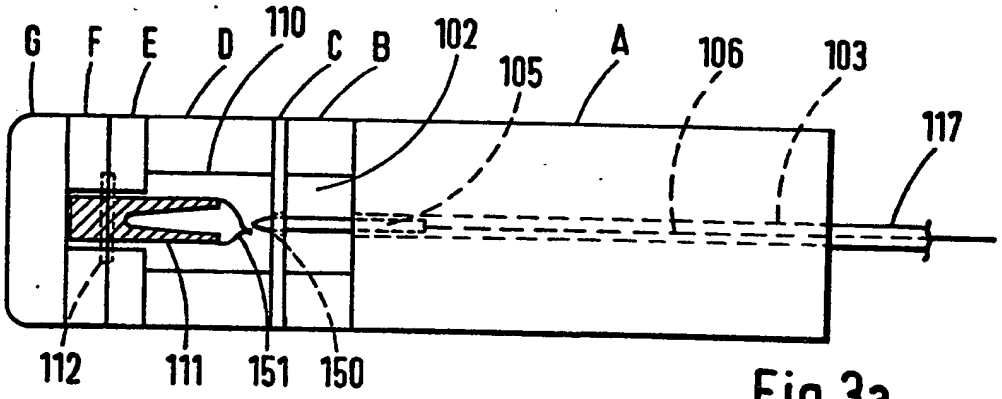


Fig.3a

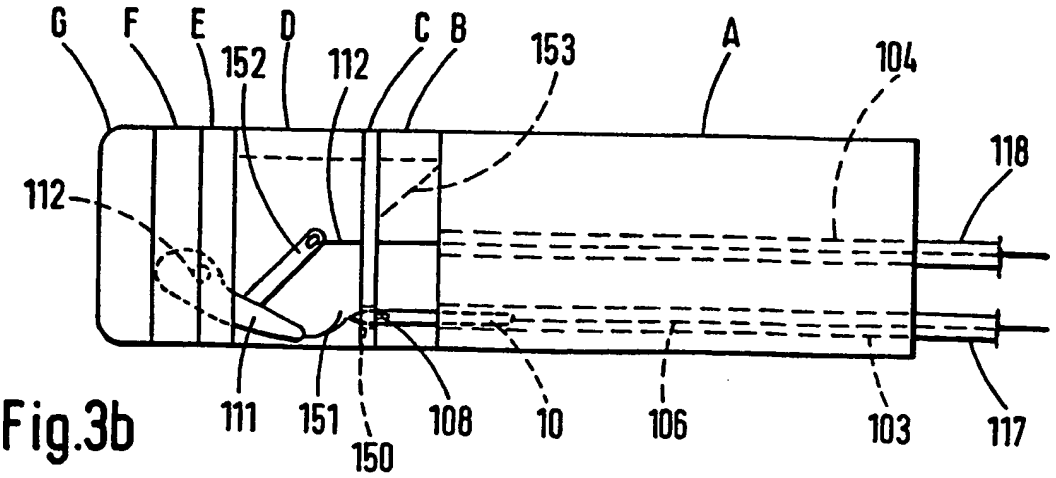


Fig.3b

0174843

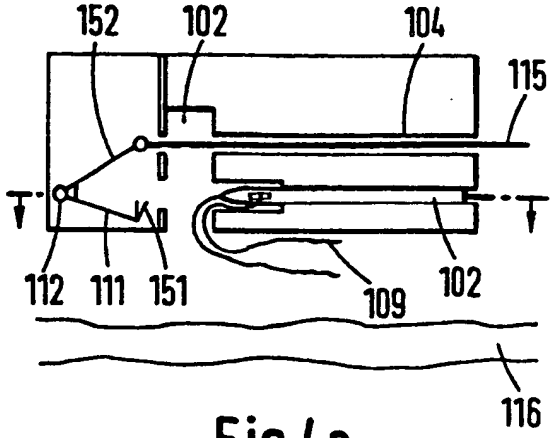


Fig.4a

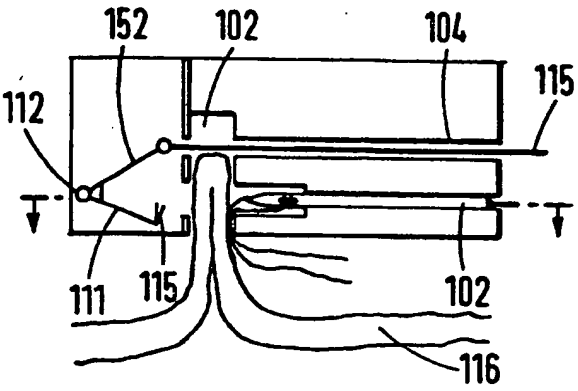
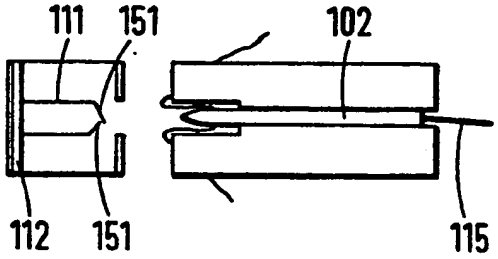
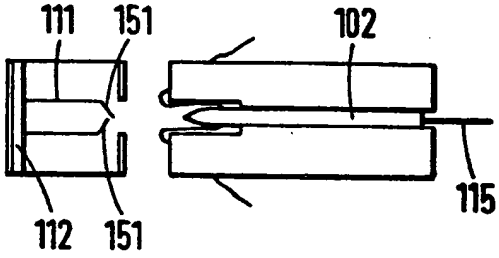


Fig.4b





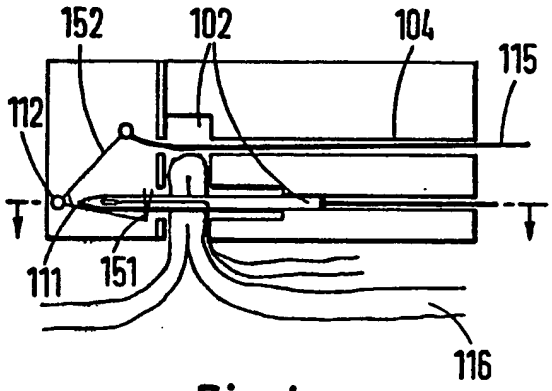


Fig.4c

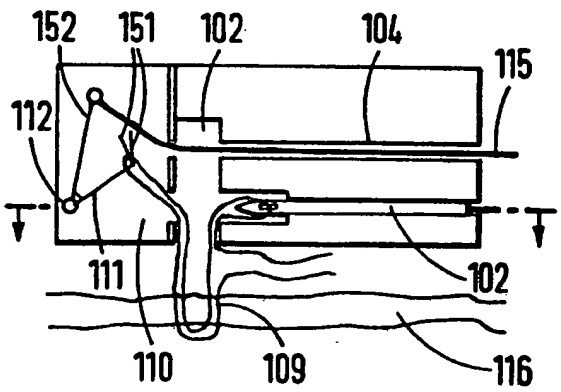
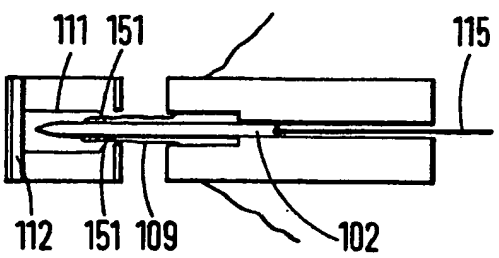
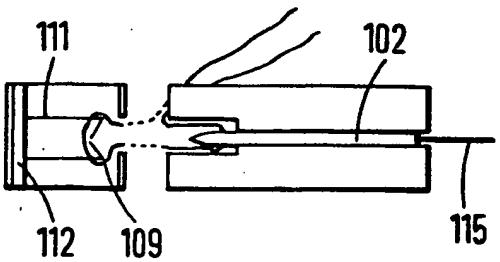


Fig.4d





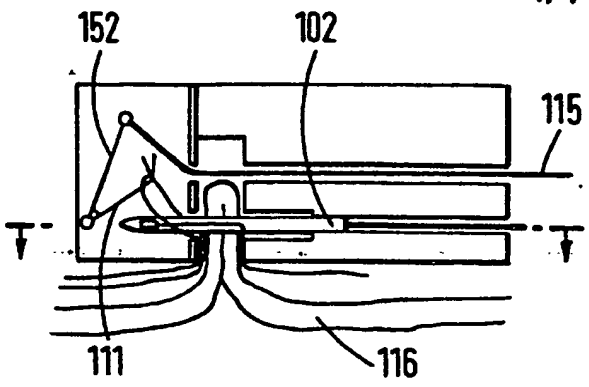


Fig.4e

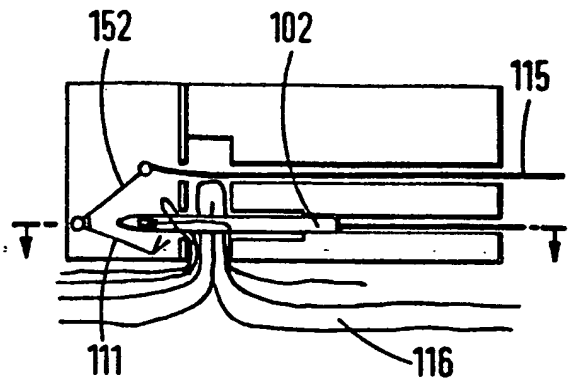
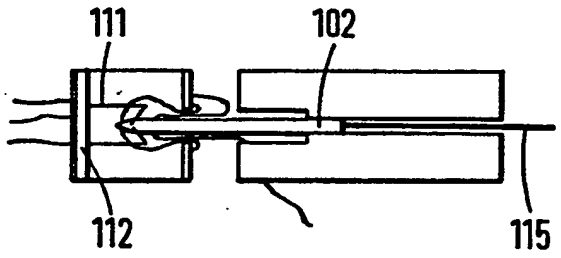
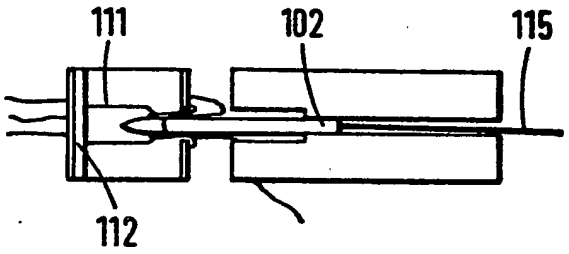


Fig.4f





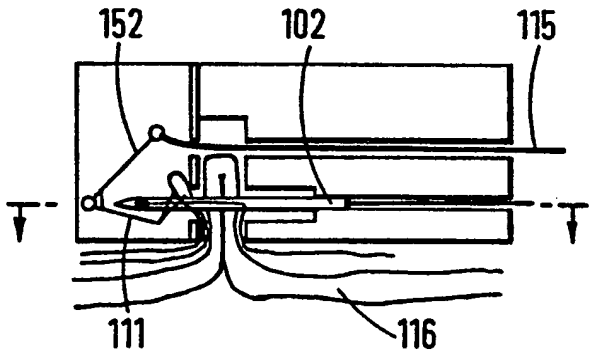


Fig.4g

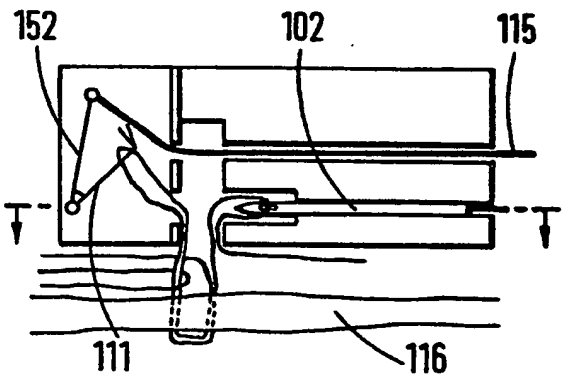
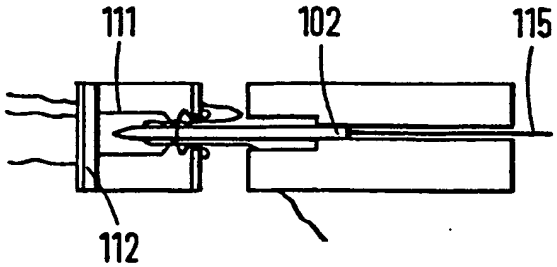
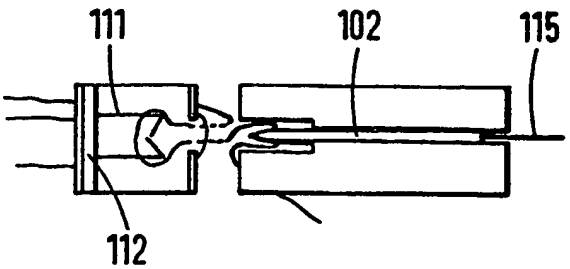


Fig.4h





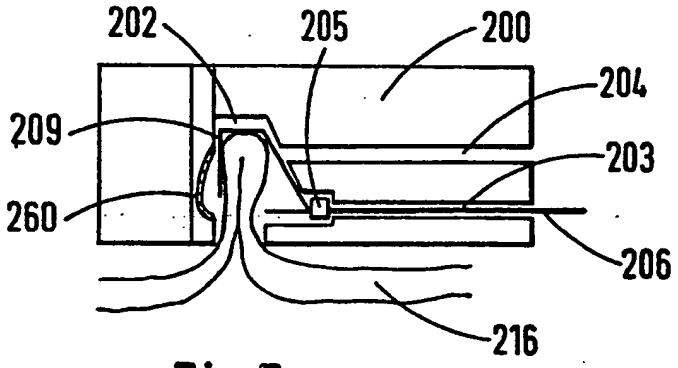


Fig.5a

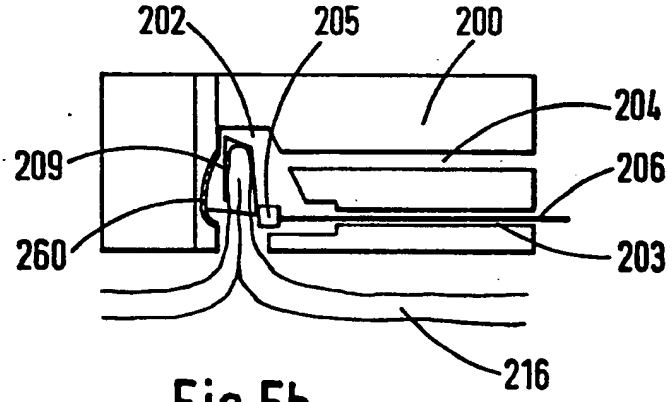


Fig.5b

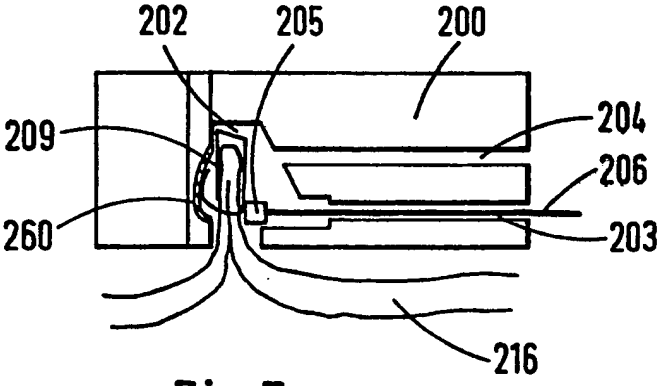


Fig.5c

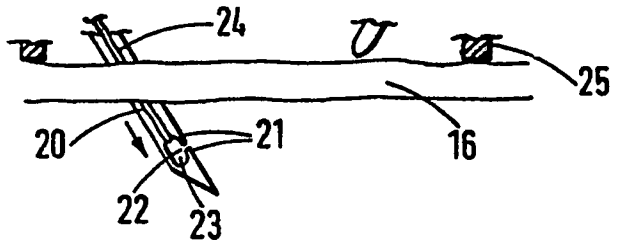


Fig.6a

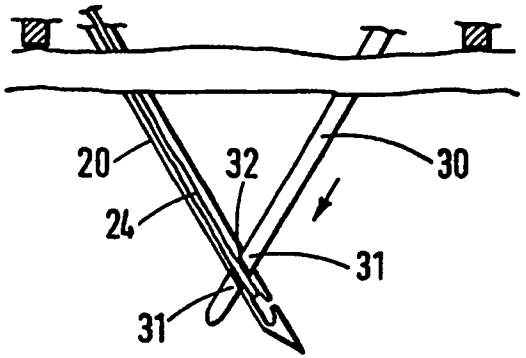


Fig.6b

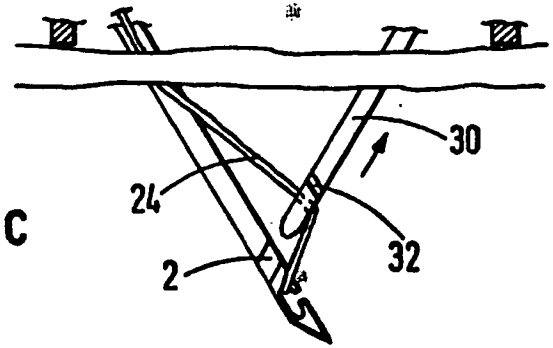


Fig.6c

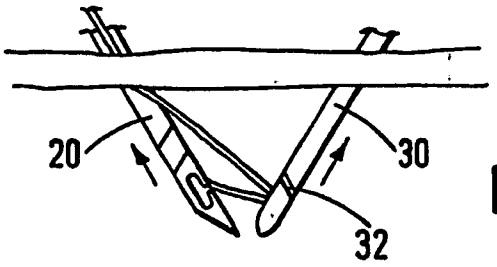


Fig.6d

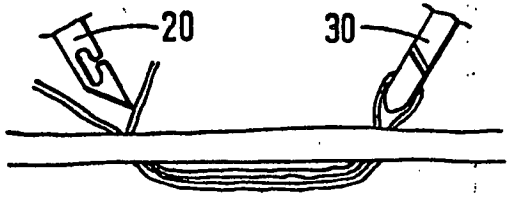


Fig.6e

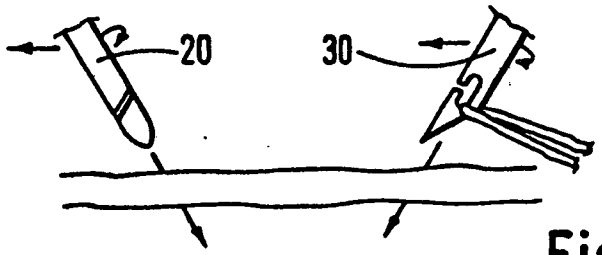


Fig.6f

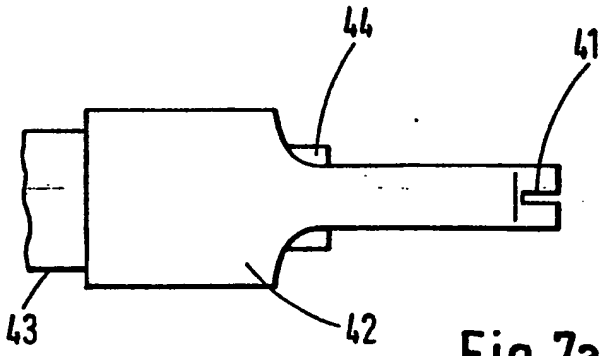


Fig.7a

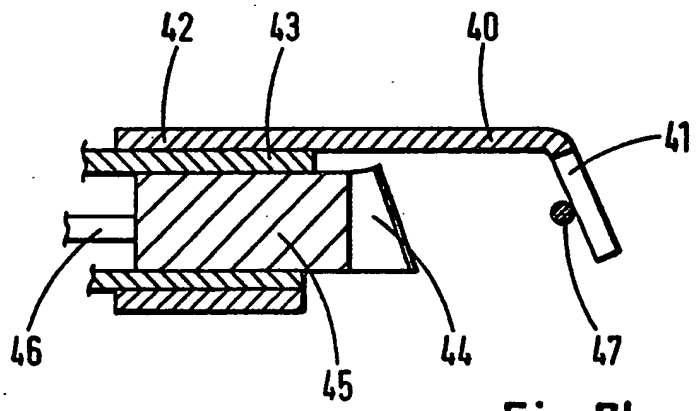


Fig.7b

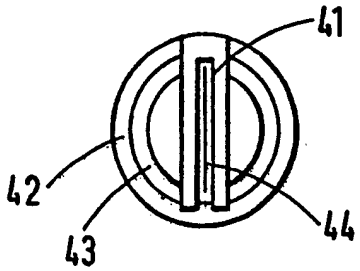


Fig.7c